v. 4

d teacher: Use this cover sheet for mailing or faxing.

ASSIGNMENT BOOKLET
SCN3260 Physics 30
Module 7 Assignment

FOR STUDENT USE ONLY	
Date Assignment Submitted: ______	(If label is missing or incorrect)
	Student File Number: ______
Time Spent on Assignment: ______	Module Number: ______

FOR OFFICE USE ONLY

Assigned Teacher: ______

Assignment Grading: ______

Graded by: ______

Date Assignment Received:

Student's Questions and Comments

Apply Module Label Here

Name

Address

Postal Code

Please verify that preprinted label is for correct course and module.

Teacher's Comments

______
Teacher

INSTRUCTIONS FOR SUBMITTING THIS DISTRIBUTED LEARNING ASSIGNMENT BOOKLET

When you are registered for distributed learning courses, you are expected to regularly submit completed assignments for correction. Try to submit each Assignment Booklet as soon as you complete it. Do not submit more than one Assignment Booklet in one subject at the same time. Before submitting your Assignment Booklet, please check the following:

- Are all the assignments completed? If not, explain why.
- Has your work been reread to ensure accuracy in spelling and details?
- Is the booklet cover filled out and the correct module label attached?

MAILING

1. Do **not** enclose letters with your Assignment Booklets. **Send all letters in a separate envelope.**

2. Put your Assignment Booklet in an envelope and take it to the post office and have it weighed. Attach **sufficient postage** and seal the envelope.

FAXING

1. Assignment Booklets may be faxed to the school with which you are registered. Contact your teacher for the appropriate fax number.

2. All faxing costs are the responsibility of the sender.

E-MAILING

It may be possible to e-mail your completed Assignment Booklet to the school with which you are registered. You also may be **required** to e-mail some of your assignments. Contact your teacher for the appropriate e-mail address.

Physics 30

Learn EveryWare

we explore

Investigating the Nature of the Atom

Module 7

Assignment Booklet

Red Deer Catholic Regional Schools

EDMONTON PUBLIC SCHOOLS

Calgary Board of Education

Alberta Education

FOR TEACHER'S USE ONLY

Summary

	Total Possible Marks	Your Mark
Lesson 1 Assignment	26	
Lesson 2 Assignment	30	
Lesson 3 Assignment	30	
	86	

Teacher's Comments

Physics 30 Learn EveryWare
Module 7: Investigating the Nature of the Atom
Assignment Booklet
ISBN 978-0-7741-3208-4

Cover Art: © Rose Hayes/shutterstock

This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	
General Public	
Other	

You may find the following Internet sites useful:

- Alberta Education, **http://www.education.gov.ab.ca**
- Learning Resources Centre, **http://www.lrc.education.gov.ab.ca**
- Tools4Teachers, **http://www.tools4teachers.ca**

Exploring the electronic information superhighway can be educational and entertaining. However, be aware that these computer networks are not censored. Students may unintentionally or purposely find articles on the Internet that may be offensive or inappropriate. As well, the sources of information are not always cited and the content may not be accurate. Therefore, students may wish to confirm facts with a second source.

MODULE 7: LESSON 1 ASSIGNMENT

This Module 7: Lesson 1 Assignment is worth 26 marks. The value of each assignment and each question is stated in the left margin.

(26 marks) **Lesson 1 Assignment: Cathode Rays and Thomson's Experiment**

(2 marks) **A 1.** What was the evidence that the cathode rays were particles with charge and mass?

(3 marks) **A 2.** What is the charge-to-mass ratio of a particle travelling 3.60×10^5 m/s that is deflected in an arc of radius 7.40 cm as it travels through a magnetic field of 0.610 T?

(3 marks) **A 3.** Some positively charged particles are found to pass undeflected through perpendicular magnetic and electric fields. The magnetic field strength is 0.650 T, and the electric field strength is 2.10×10^5 N/C. What is the speed of the particles?

(3 marks) **A 4.** Alpha particles travel through a magnetic field of 0.360 T and are deflected in an arc of 0.0820 m. Assuming the alpha particles are perpendicular to the field, what is the energy of an individual alpha particle?

(3 marks) **A 5.** Using the charge of an electron (determined by Millikan in another experiment to be 1.60×10^{-19} C) and the charge-to-mass ratio of the electron (determined by Thomson to be 1.76×10^{11} C/kg), calculate the mass of an electron.

(3 marks) **A 6.** A particle accelerated by a potential difference enters a velocity selector. The particle travels straight when the magnetic field is 0.400 T and the electric field is 6.30×10^{5} V/m. Once the electric field is turned off, a sensor determines that the radius or the particle's path is 4.11 cm.

a. What is the charge-to-mass ratio of this particle?

(2 marks) b. Use the charge-to-mass ratio of the particle to determine whether it is an alpha particle, electron, or proton. **Hint:** Check your physics data sheet for the charges and masses.

(4 marks) **RC 1.** Complete questions 1 to 3 of "THEN, NOW, AND FUTURE, The Mass Spectrometer" on page 759 of your physics textbook.

1.

2.

3.

(3 marks) **A 7.** How did Thomson's discovery of the electron change the current Dalton model of the atom, and why was this an extremely significant change?

____

____

____

____

____

____

____

____

MODULE 7: LESSON 2 ASSIGNMENT

This Module 7: Lesson 2 Assignment is worth 30 marks. The value of each question is stated in the left margin.

(30 marks) **Lesson 2 Assignment—The Millikan Experiment**

(3 marks) **LAB 1.**

You will need to go to the Physics 30 Multimedia DVD and open "Millikan Experiment Simulation" to complete this question.

Use the following procedures to re-enact Millikan's experiment.

1. On the simulation, select the reticle view ( ) and make sure that the electric field is off ( ).
2. Inject oil droplets into the apparatus by clicking the inject button ( ) a few times. You should see the droplets moving down.
3. Toggle the field on and off a couple of times (or shortcut key V). When the field is on, you should see some of the droplets move up.
4. Look for a droplet that moves both up and down slowly. Select this droplet by clicking on it with your mouse, and verify that it changes colour.
5. When your selected droplet is well above the top line of the reticle, turn the field off. As the droplet is falling,
   - start the timer (or shortcut key M) when it passes the top line of the reticle
   - stop the timer (or shortcut key M) when it passes the bottom line of the reticle (this is the fall time)
6. After the droplet has passed the bottom line of the reticle, switch the field on. As the droplet is rising,
   - start the timer (or shortcut key M) when it passes the bottom line of the reticle
   - stop the timer (or shortcut key M) when it passes the top line of the reticle (this is the rise time)
7. Repeat steps 5 and 6 five times for your selected droplet.

8. Click the data button ( ) and view the “Collected Data.” Millikan used the rise and fall times, the mass of the droplet (determined by volume and density), and forces related to air resistance to determine its charge. Note that you will see information related to these values when you click **Data** and select the “Data Analysis” tab.

   Record the average rise velocity, average fall velocity, and charge of your oil droplet.

   Average rise velocity:

   Average fall velocity:

   Charge of your oil droplet:

(1 marks) **A 1.** Why was Millikan unable to use water to make the droplets?

____

____

____

____

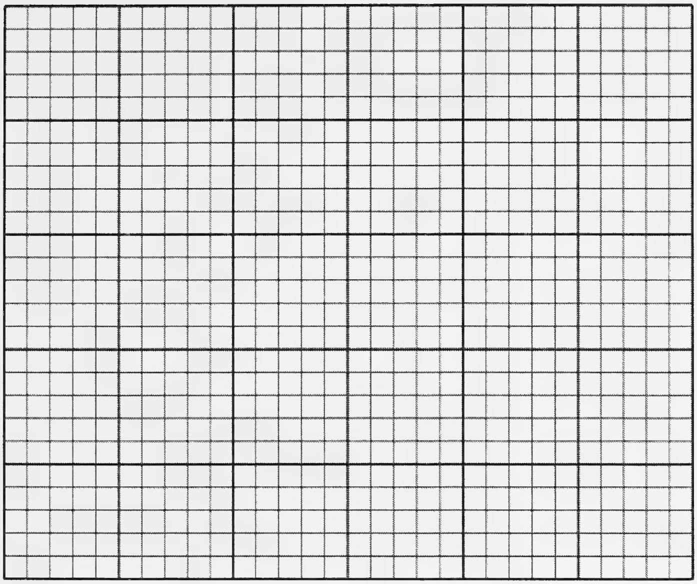
____

(2 marks) **A 2.** Why was Millikan's oil drop experiment so important for the development of models of the atom?

(6 marks) **A 3.** During a Millikan oil drop experiment, a student records the weight of five different droplets. A record is also made of the electric field intensity needed to hold each droplet stationary between the horizontal charged plates.

Weight ($\times 10^{-14}$ N)	Electric Field Strength ($\times 10^{5}$ N/C)
1.7	1.1
5.6	3.5
6.1	3.8
2.9	1.8
4.0	2.5

Graph the recorded data. Using ONLY the graph, determine the elementary charge.



A 4. In a Millikan-type experiment, two horizontal charged plates are 2.5 cm apart. A latex sphere of 1.3×10^{-15} kg remains stationary between the plates when the potential difference between the plates is 400 V, with the upper plate positively charged.

(1 mark) a. What is the type of charge on the sphere?

(2 marks) b. What is the electric field intensity between the plates?

(3 marks) c. What is the charge on the sphere?

(2 marks) d. How many excess elementary charges are on the sphere?

A 5. Two large, horizontal charged plates are separated by 0.050 m. A small plastic sphere is suspended between them and is experiencing a force of 4.5×10^{-15} N.

(3 marks) a. If the sphere has four excess electrons, what is the mass of the sphere?

(3 marks) b. What is the potential difference between the plates?

(4 marks) **D 1.** Millikan's experimental discoveries are, to some extent, a product of the scientific culture in which he lived and worked. Go to the Physics 30 Multimedia DVD and view the video clip, "Millikan—Scientific Climate." Summarize the scientific climate in which Millikan performed his work.

MODULE 7: LESSON 3 ASSIGNMENT

This Module 7: Lesson 3 Assignment is worth 30 marks. The value of each assignment and each question is stated in the left margin.

(30 marks) **Lesson 3 Assignment—The Rutherford and Bohr Models of the Atom**

Lab

Open the "Rutherford Scattering Simulation" from the Physics 30 Multimedia DVD.

(2 marks) **LAB 1.** Adjust the number of protons to the maximum of 100. Describe what happens to the amount of scattering that occurs and the angles at which it occurs. How can you explain the relationship between the amount of scattering and the number of protons in the nucleus?

(2 marks) **LAB 2.** Select the "Plum Pudding Atom" from the upper menu on the simulation. Explain why the alpha particles are no longer scattered.

A 1. According to Maxwell's laws of electromagnetism, the orbital frequency (the number of complete orbits per second) of an electron will match the frequency of the emitted radiation.

(1 mark) a. If an electron were to spiral into the nucleus, what would happen to the electron's orbital frequency?

(1 mark) b. If an electron were to spiral into the nucleus, what would happen to the frequency of the emitted radiation?

(1 mark) c. If an electron were to spiral into the nucleus, what kind of spectrum would be produced—a continuous or line spectrum? Explain.

(1 mark) d. Look at the emission spectrum of hydrogen. What kind of spectrum is this? Does Rutherford's model predict the correct spectrum?

(1 mark) **A 2.** According to Bohr, why did an atom not collapse in on itself while its electrons travelled around the nucleus?

A 3. Using Bohr's model, explain what happens in the atom when a photon of light is

(1 mark) a. emitted

(1 mark) b. absorbed

A 4. Earlier, when you read about the energy levels of hydrogen, you were introduced to an energy level diagram. On this diagram, the $n = \infty$ energy level is represented. On the applet, complete an $n = 1$ to $n = \infty$ transition and observe the energy state data.

(1 mark) a. According to the applet, what is the energy of the n = ∞ energy level?

(1 mark) b. If an electron is initially in the ground state, how much energy must the atom absorb for this transition to occur?

____

(1 mark) c. What is the radius of the $n = \infty$ energy level?

____

____

(1 mark) d. What happens to the atom if the electron "jumps" to the $n = \infty$ energy level? **Hint:** Look at the radius of this energy level. Is the electron really part of the atom anymore?

____

____

A 5. In the hydrogen atom, the electron jumps from the $n = 1$ level to the $n = 4$ level.

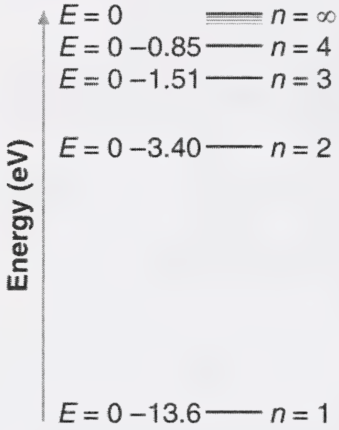
(1 mark) a. During this transition, is a photon emitted or absorbed?

____

(3 marks) b. What is the change in energy of the electron and what is the wavelength of the emitted or absorbed photon?

(2 marks) c. Identify the transition by drawing an arrow on the energy level diagram below, and calculate the wavelength of the absorbed photon.

Energy Level Diagram for Hydrogen



(3 marks) **A 6.** An electron in the third stationary state around a hydrogen atom has energy of – 1.512 eV. What will the electron's energy be if the hydrogen atom absorbs a photon with a wavelength of 109 nm?

(3 marks) **A 7.** What is the shortest wavelength photon that is emitted in the hydrogen atom? What transition emits this photon? **Hint:** If the wavelength is small, then the energy is large. Looking at the energy level diagram will also help you.

(3 marks) **A 8.** Bohr's model of the atom explains why emission and absorption lines match up. Prove this for the hydrogen atom. Choose any transition (and its opposite) and calculate the wavelength of the emitted and absorbed photon. Verify your answer using the applet.